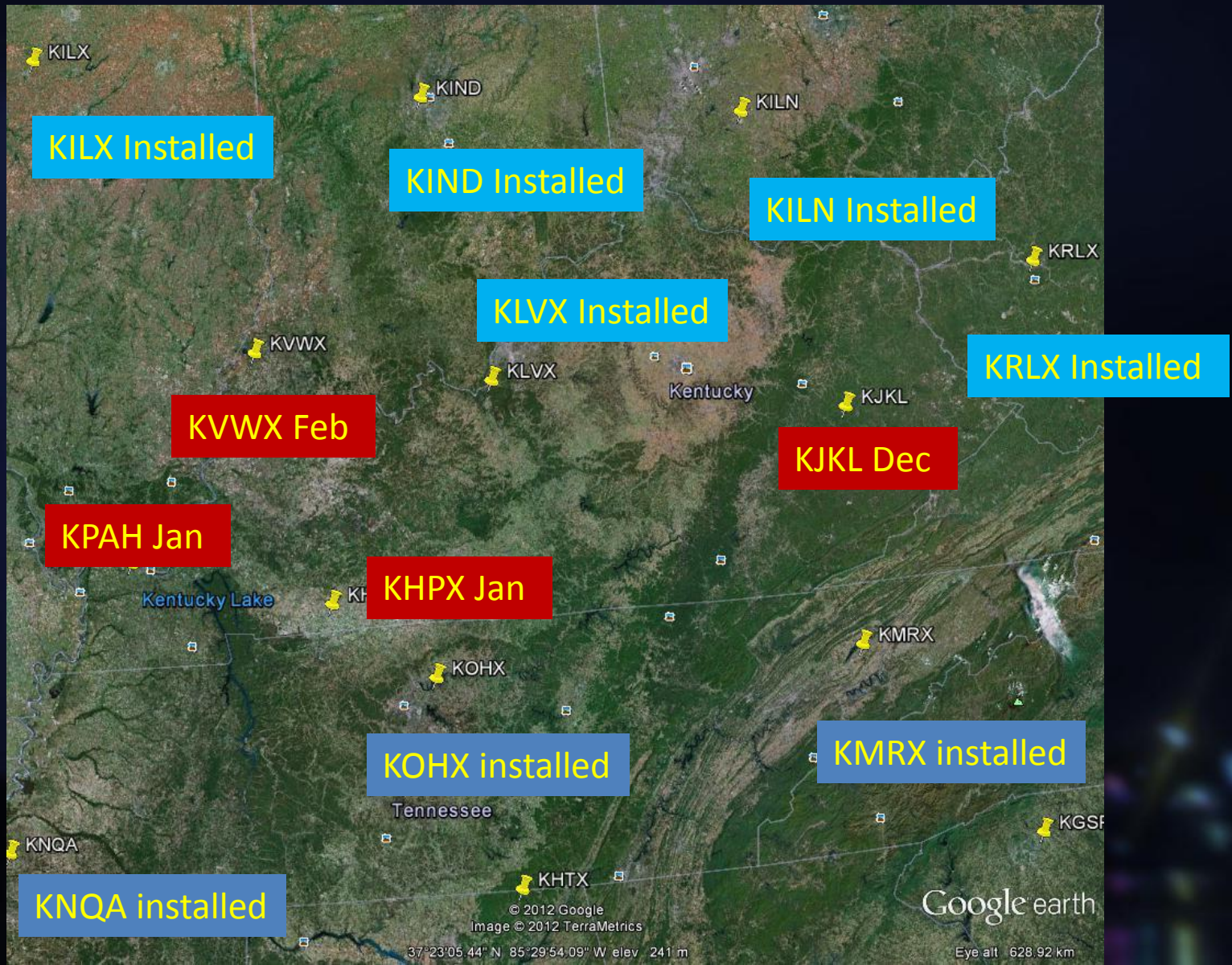




# Dual Pol Radar *Applications*

Pat Spoden  
Science & Operations Officer  
National Weather Service  
Paducah, KY  
Fall 2012

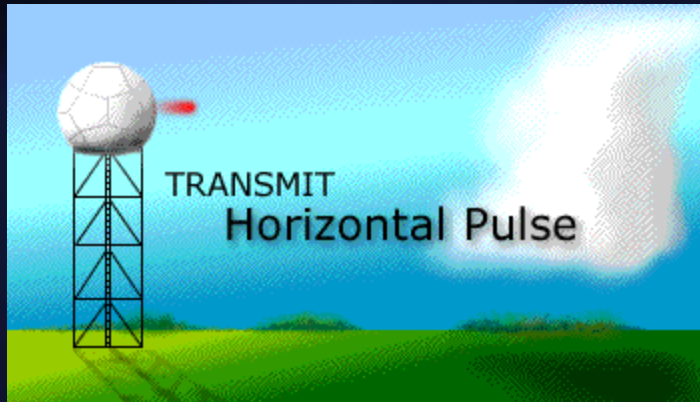
# Schedule



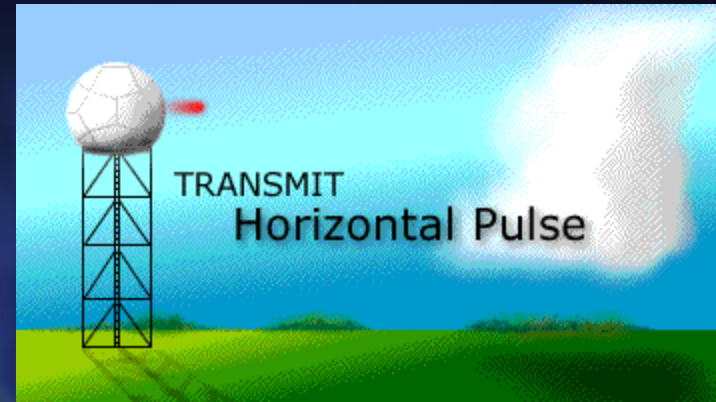
# Training for YOU

- Training for Non-NWS Meteorologists and Non-Meteorologists
- <http://www.wdtb.noaa.gov/courses/dualpol/Outreach/index.html>

# Basics



Current WSR-88D



Dual Pol Radars



# What Can You Expect

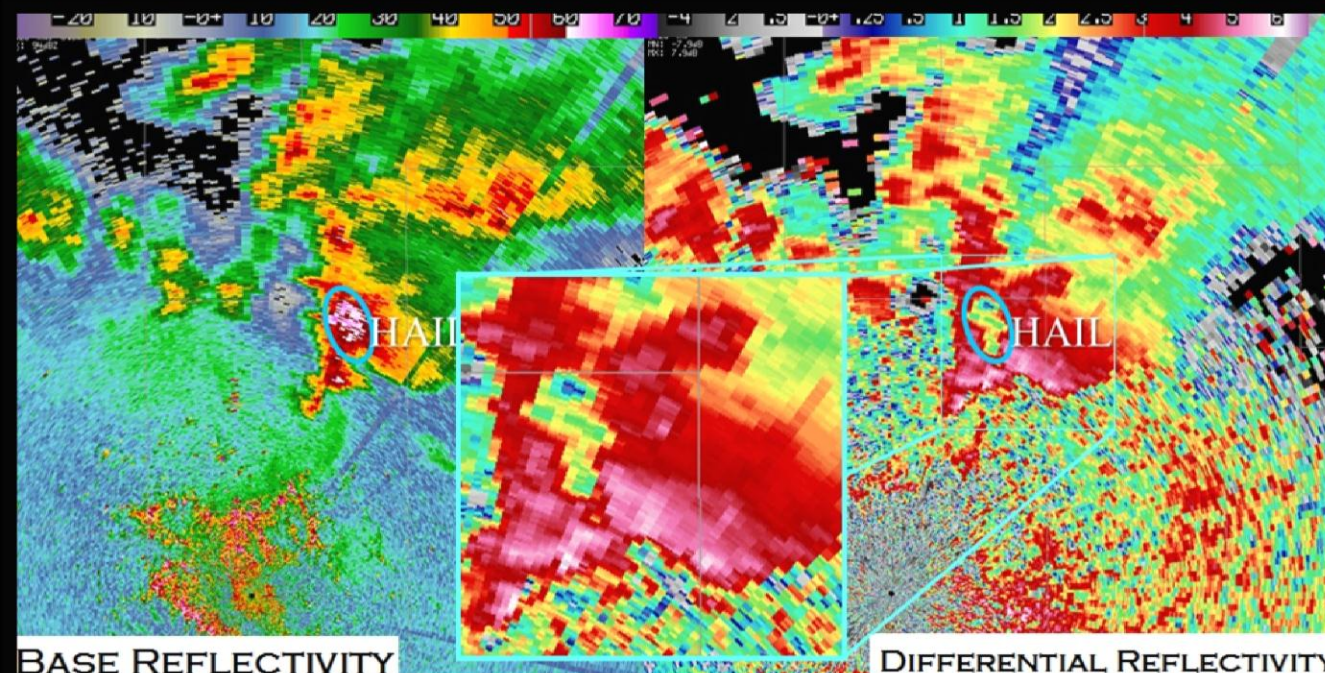
- New products + the old products
- Improved rainfall estimates
- Ability to locate different types of precipitation
- More confidence when tornadoes are on the ground

# Basics

- **CC** – Correlation Coefficient – How similar are surrounding raindrops/particles to each other?
  - *High CC = high similarity*
- **ZDR** – Differential Reflectivity – Is the raindrop/hail/particle round?
  - *Things that tumble appear to be round*
- **KDP** – What is the size and concentration of rain/particles?
  - *Larger drops and higher concentration = larger KDP*

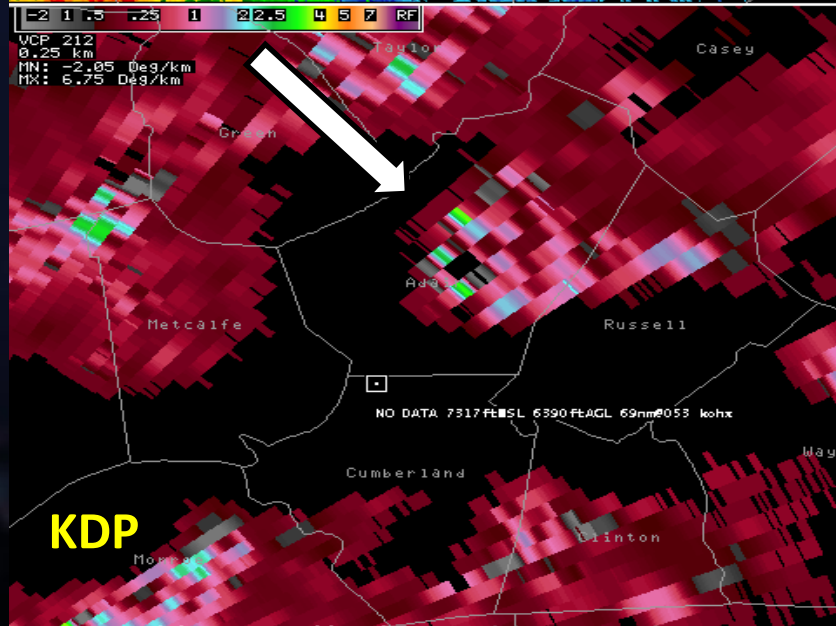
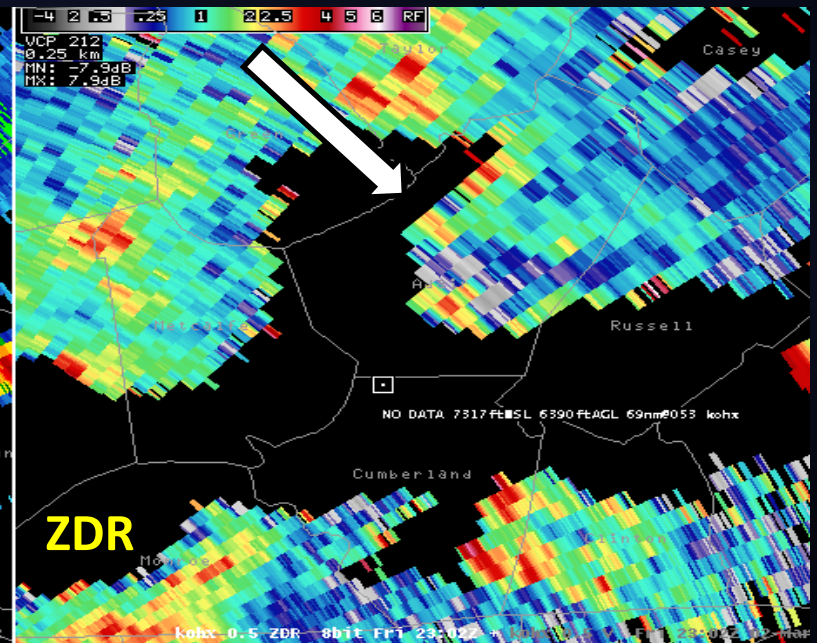
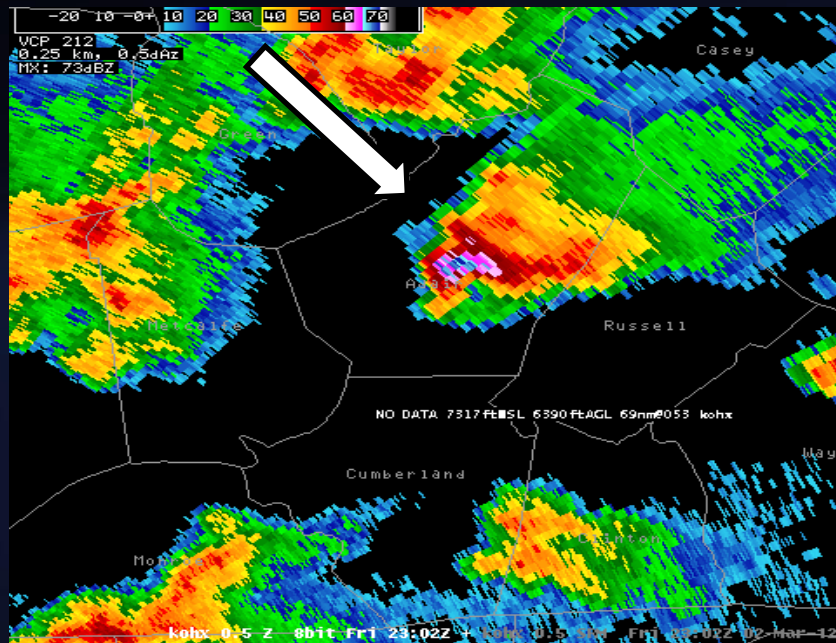
# Dual-Pol Base – Hail Detection

- Very high Z ( $> 55$  dBZ)
- Variable ZDR:
  - Usually low ( $-0.5$  -  $+1.5$  dB)
  - Positive when mixed with rain!
- Low CC ( $0.70$ - $0.95$ )
- If melting hail, high KDP ( $>1.5$  deg/km)



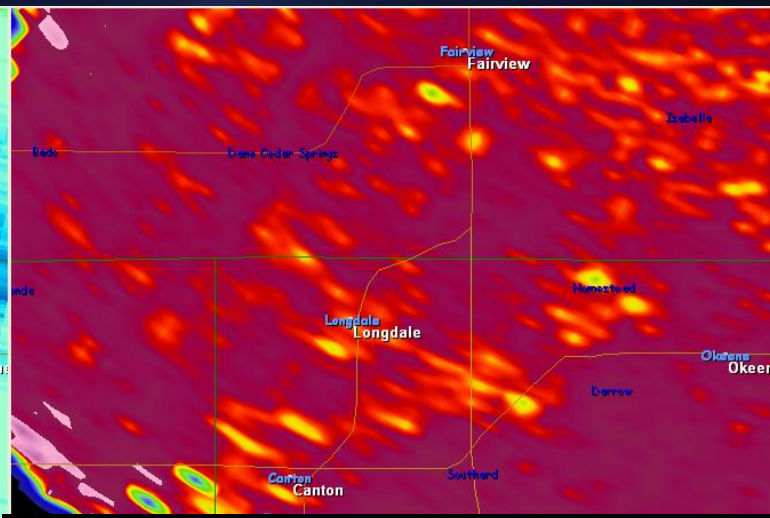
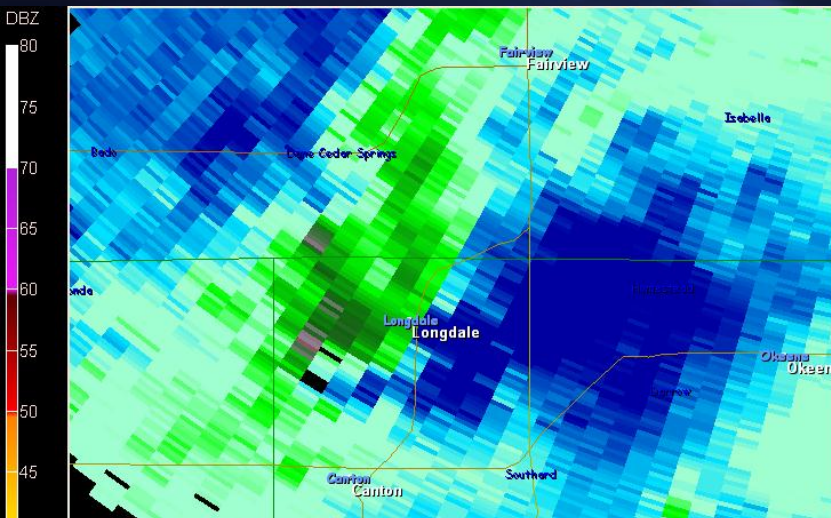


# March 2, 2012 Damaging Hail Near Columbia in Adair County

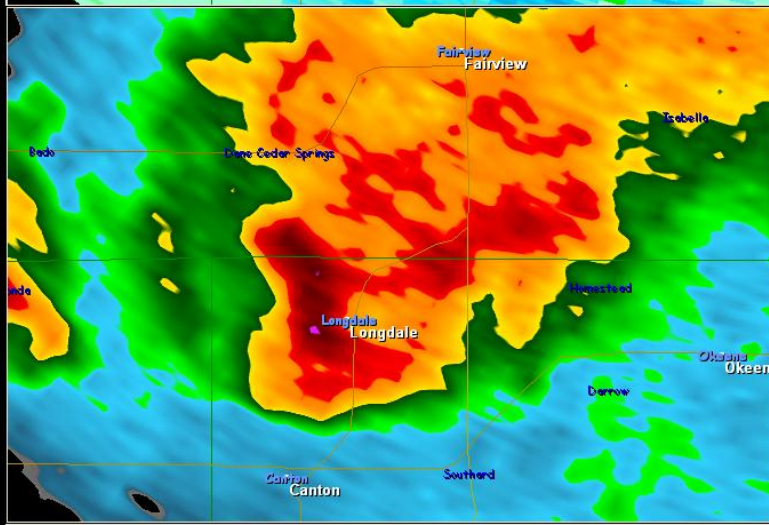




# Tornadic Debris Aloft from Vance AFB, OK – 5/24/11



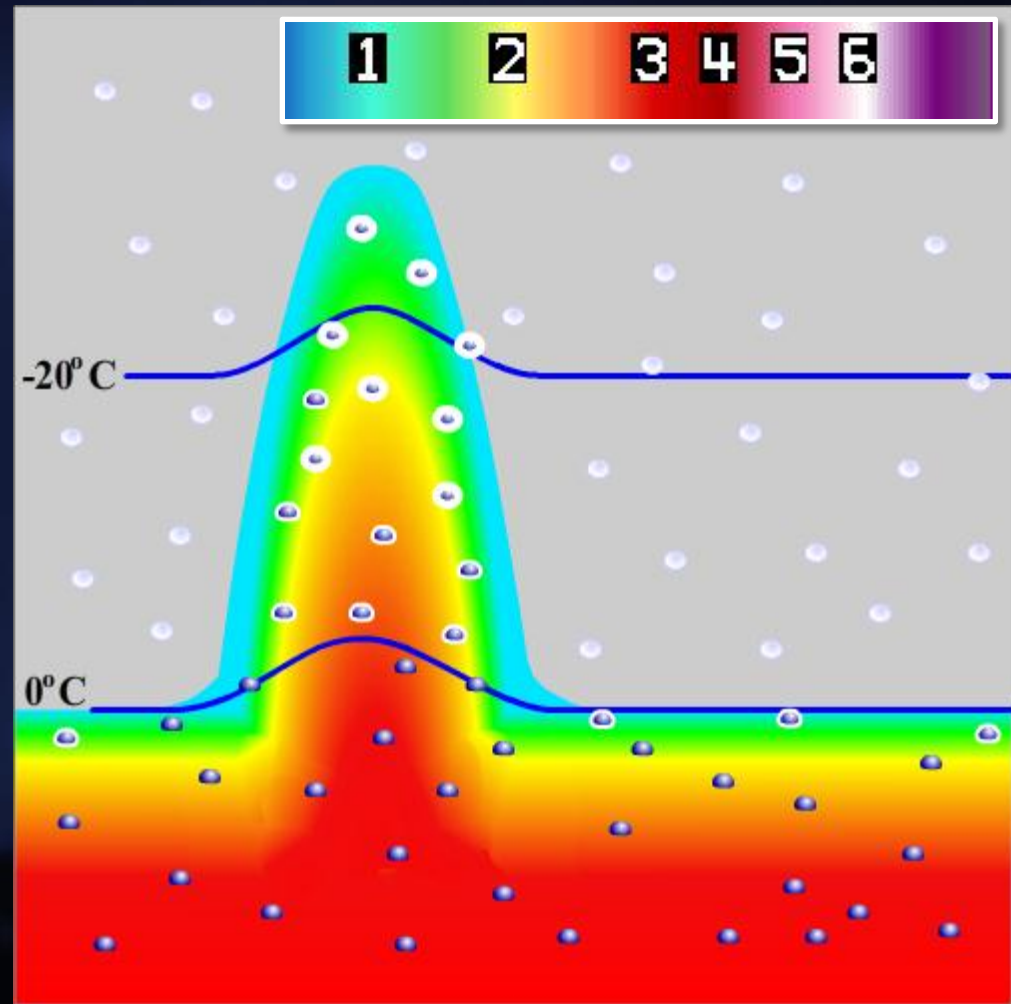
30,000 ft



- CC at  $6.4^\circ$
- Debris signature hardly noticeable, however there is an area of low CC where there is rotation and higher level of reflectivity aloft
- Low CC values – less than 0.92

# Dual Pol – Updraft Detection

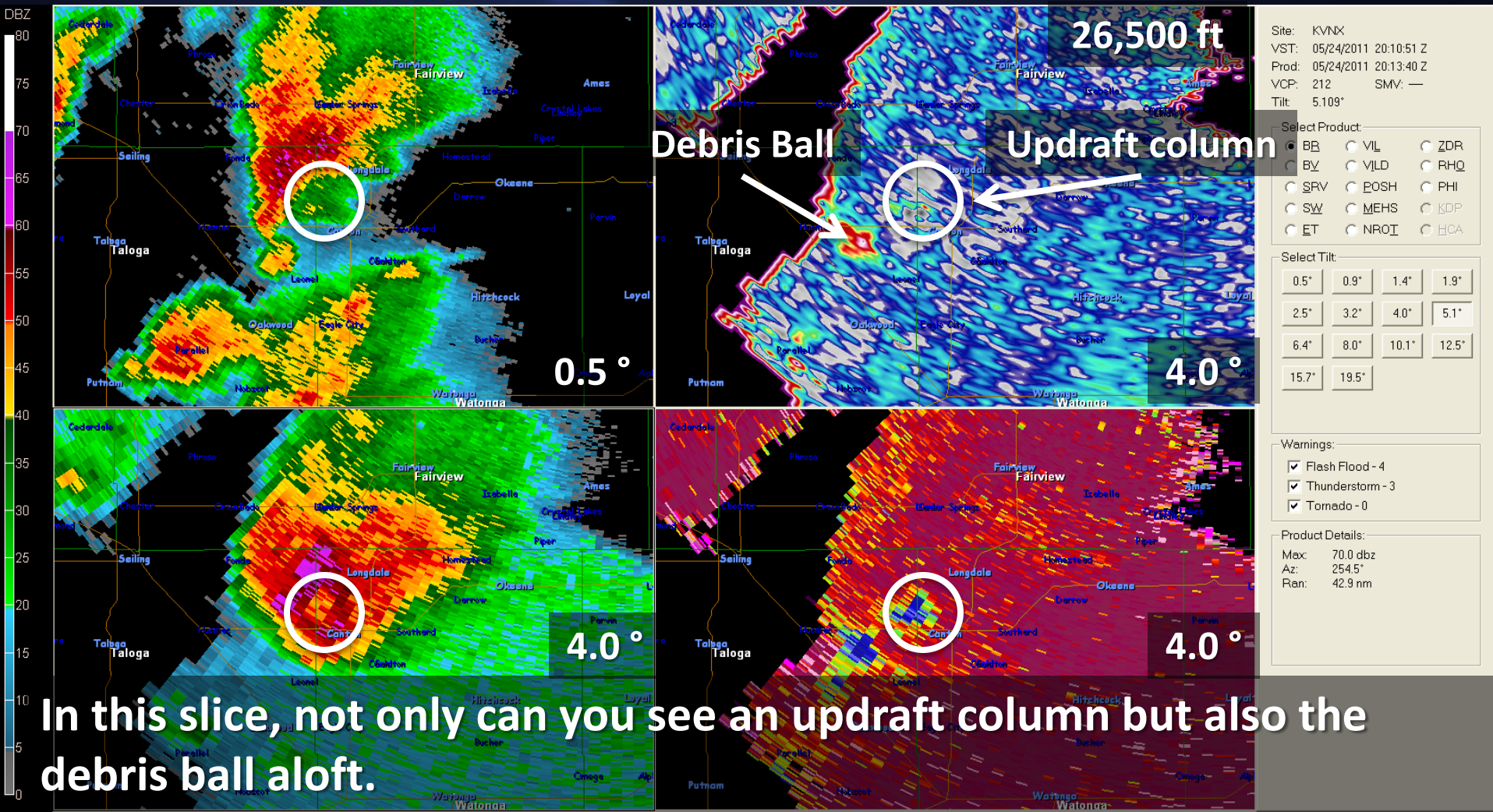
- “ZDR columns” – Regions of liquid water (strongly positive ZDR) found above the environmental  $0^{\circ}\text{C}$  height





# Updraft Detection

## ZDR Column from KVNx on 05/24/11

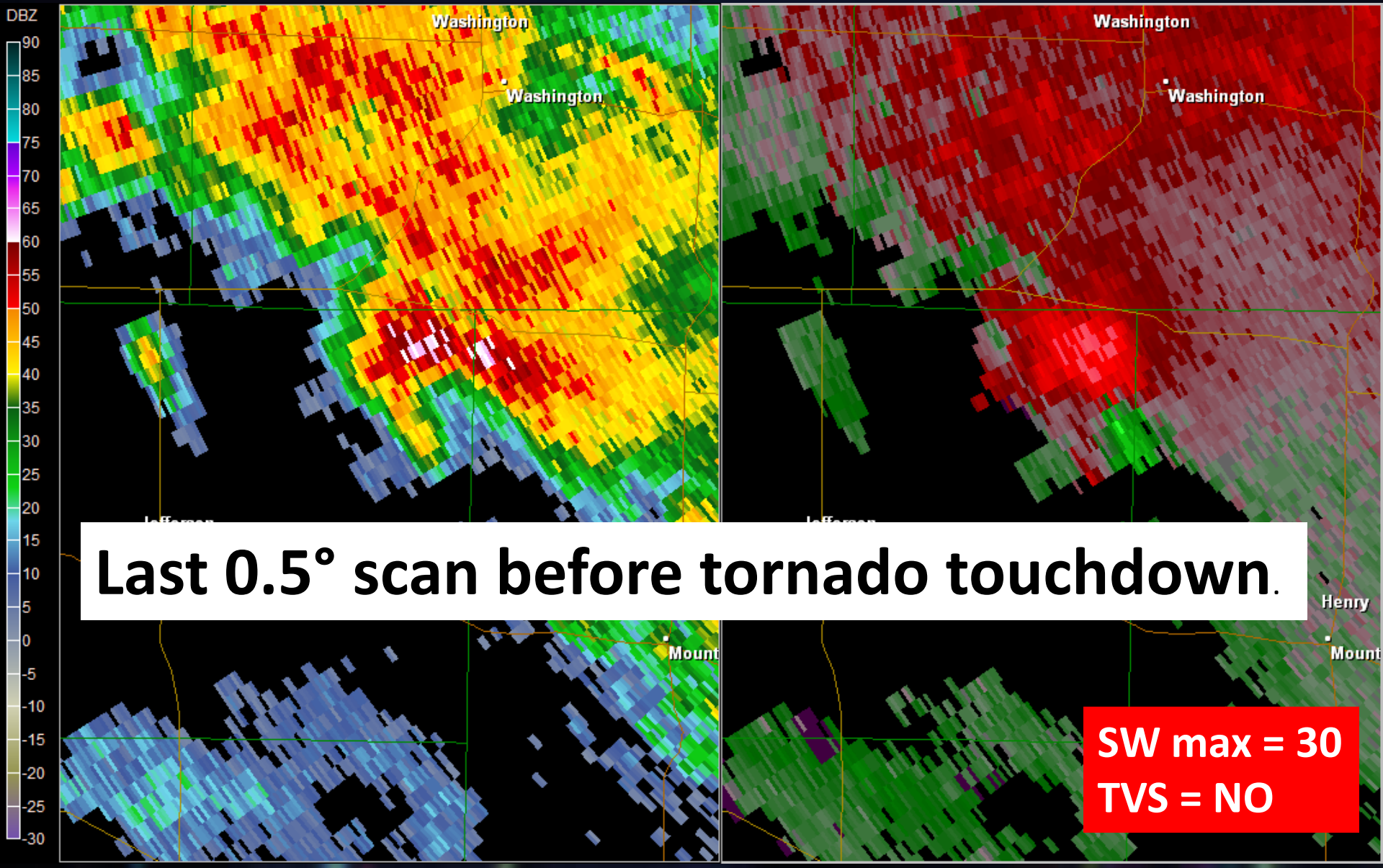




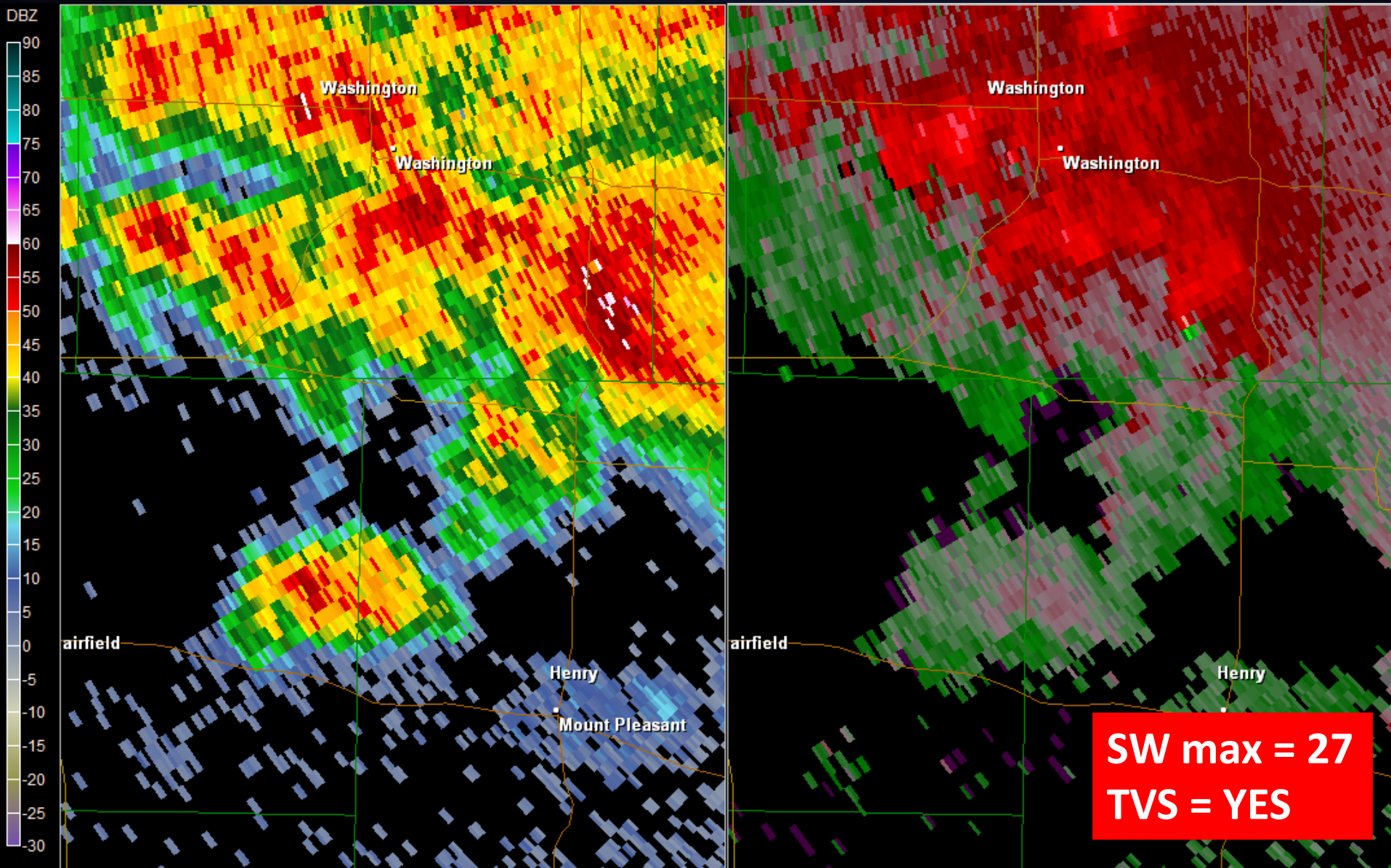




# KDVN 0.5° Z / SRM 0127Z

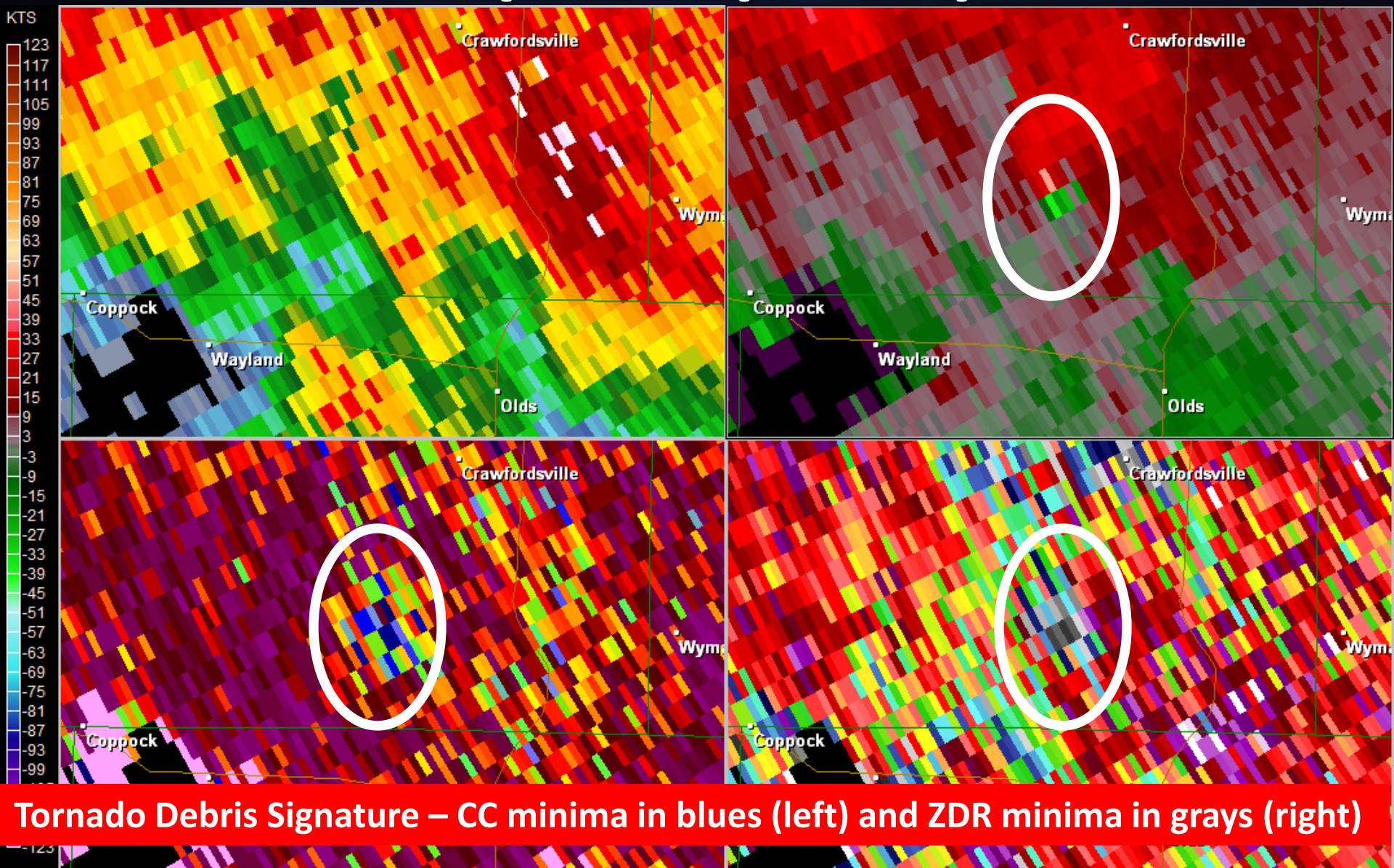


# KDVN 0.5° Z / SRM 0157Z

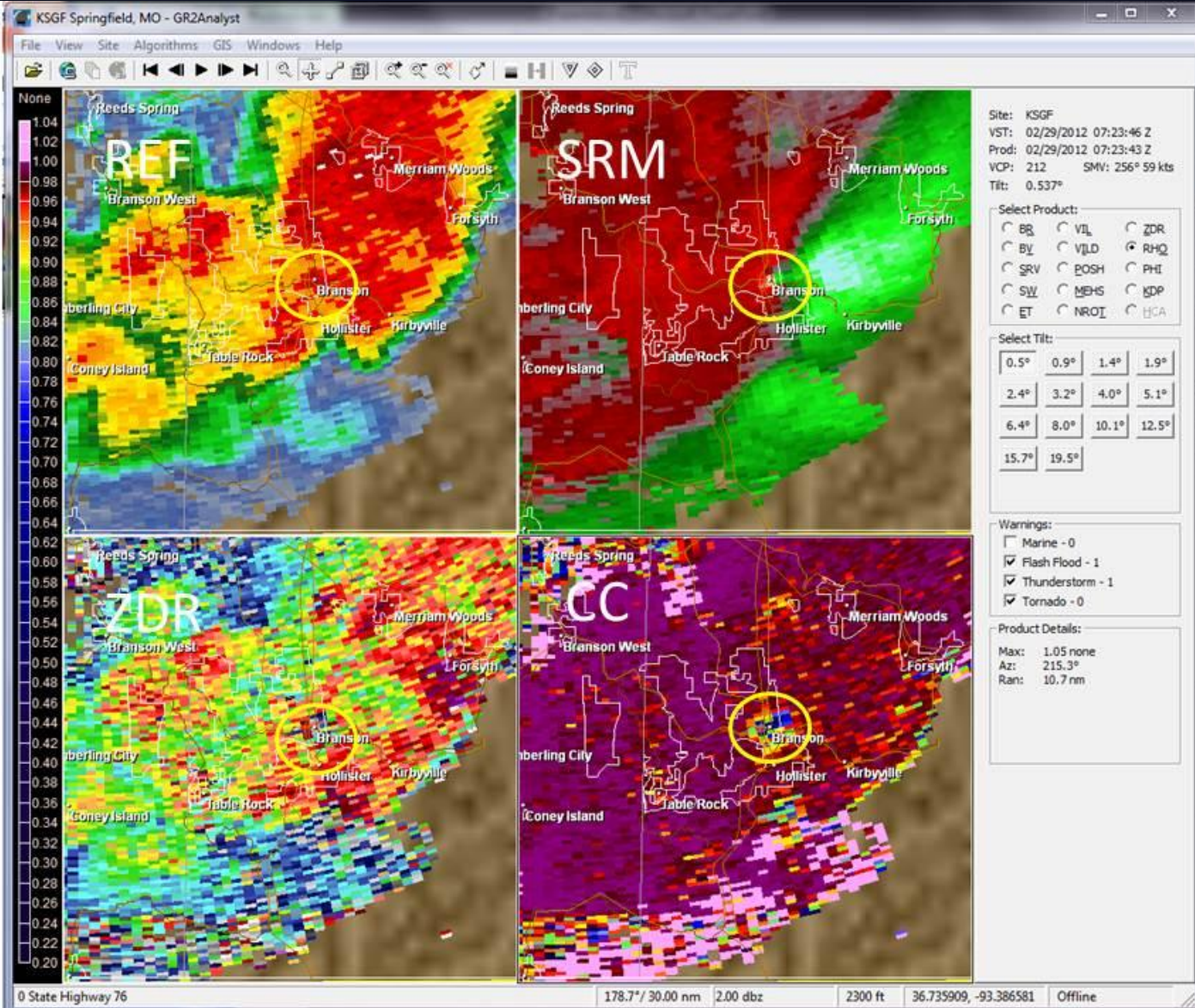




# KDVN 0.5° Z / SRM / ZDR / CC 0157Z



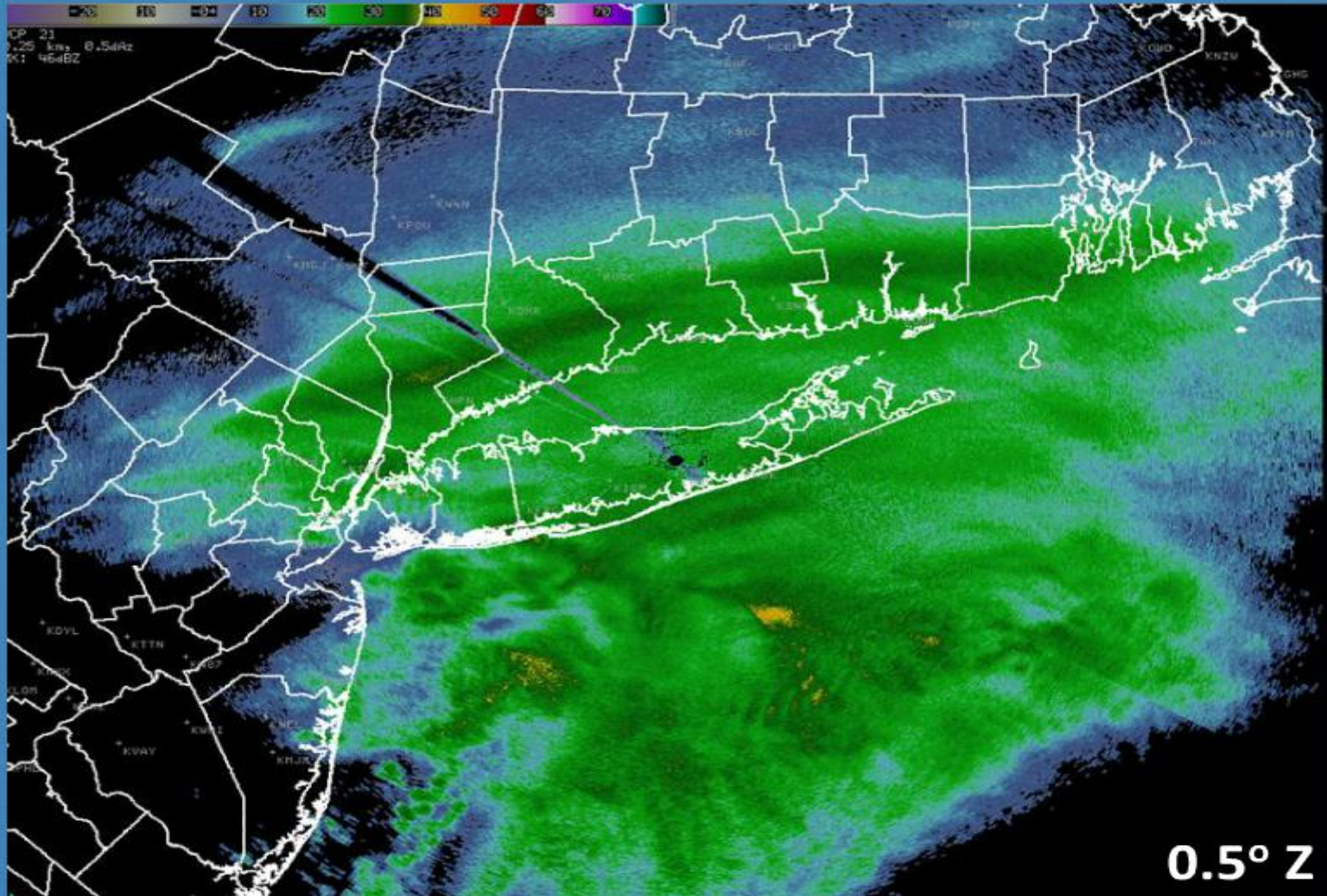
# Branson, MO





# Snow over Long Island

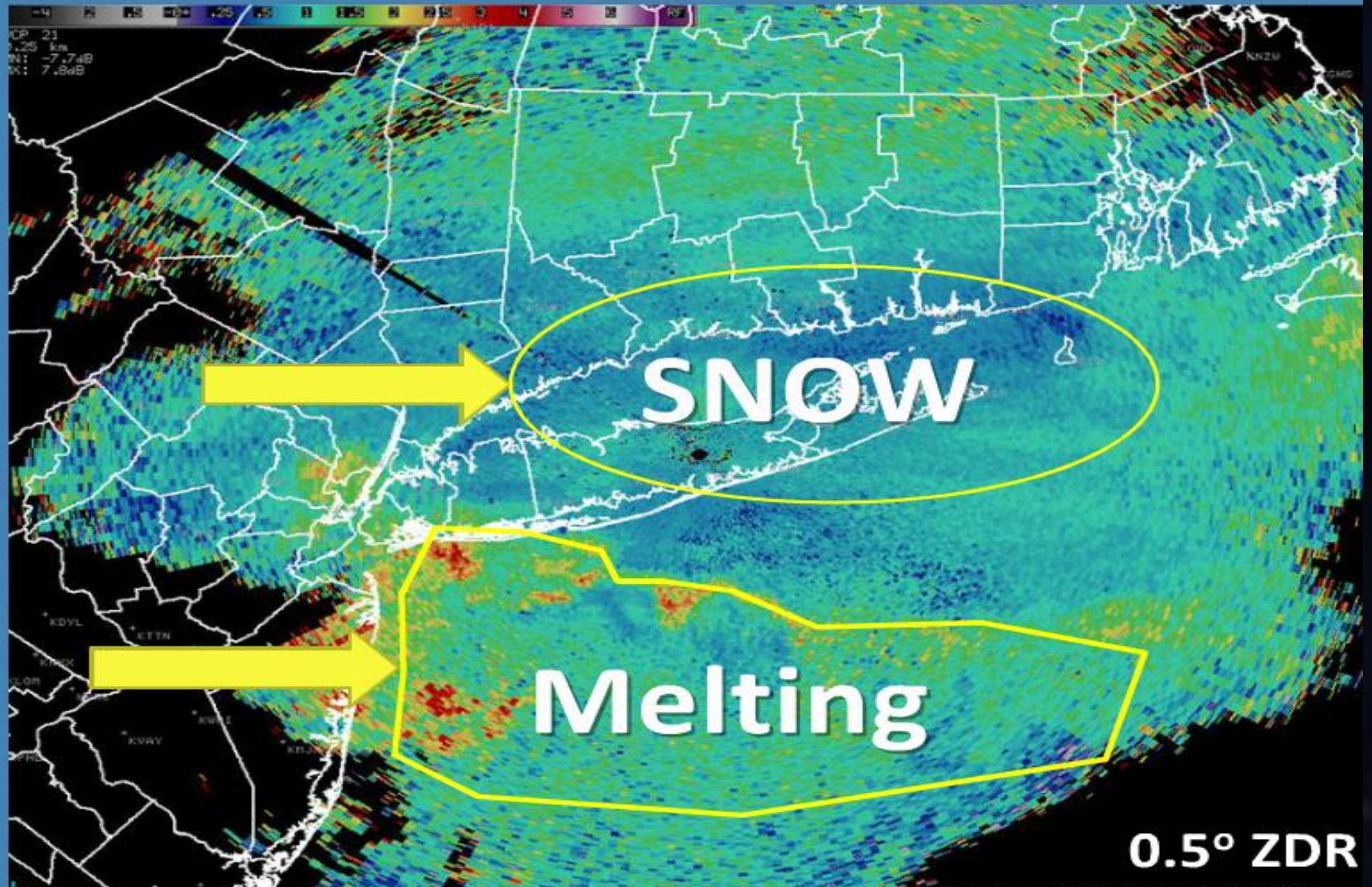
# Radar Setup – 1/21/12 KOKX @ 1528 UTC





# Snow has a low ZDR ... $< 1$

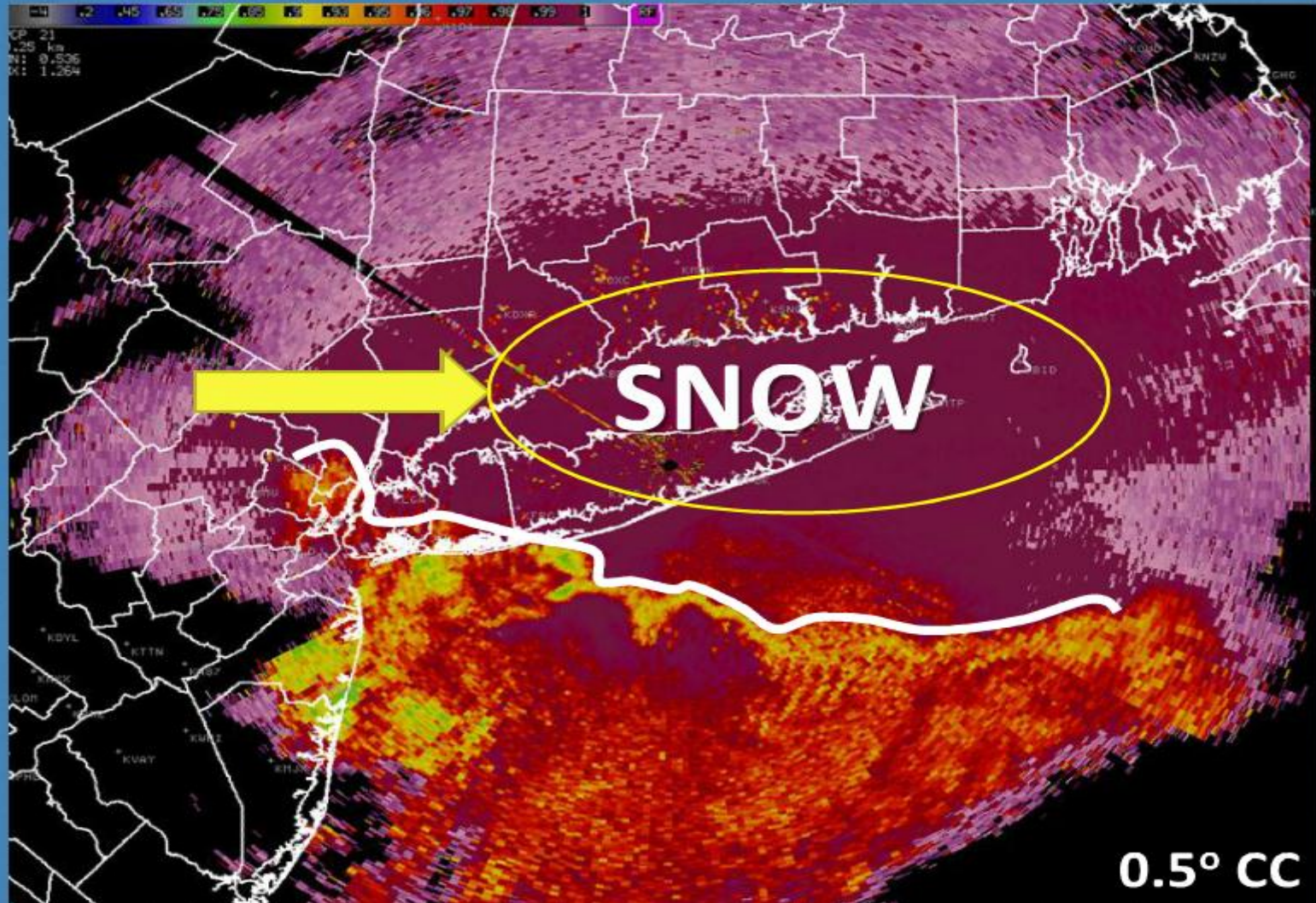
# Radar Setup – 1/21/12 KOKX @ 1528 U





# Snow has a very high CC .... $> 0.97$

## Radar Setup – 1/21/12 KOKX @ 1528 UTC

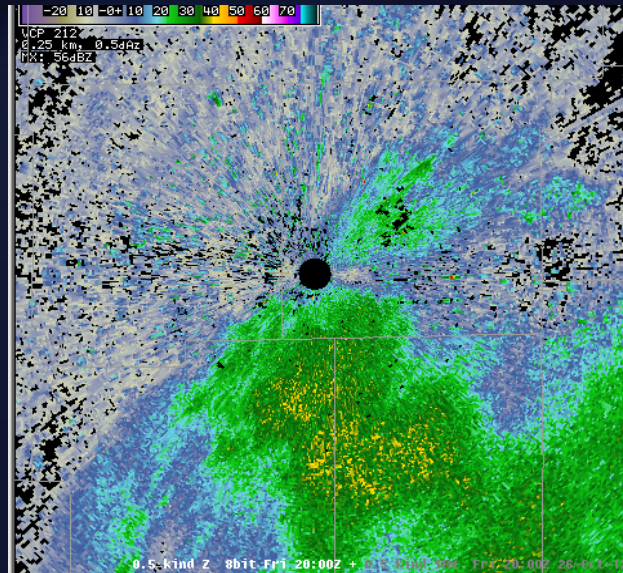




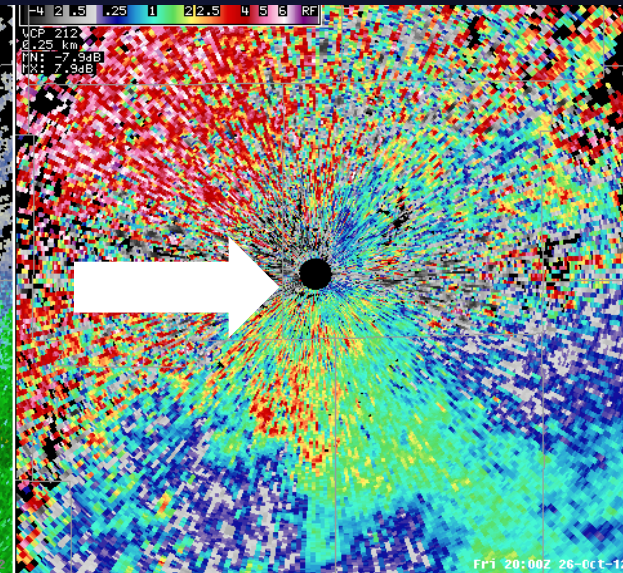
# 20Z 10-26. Very light graupel @ IND

## Note noisy ZDR and CC

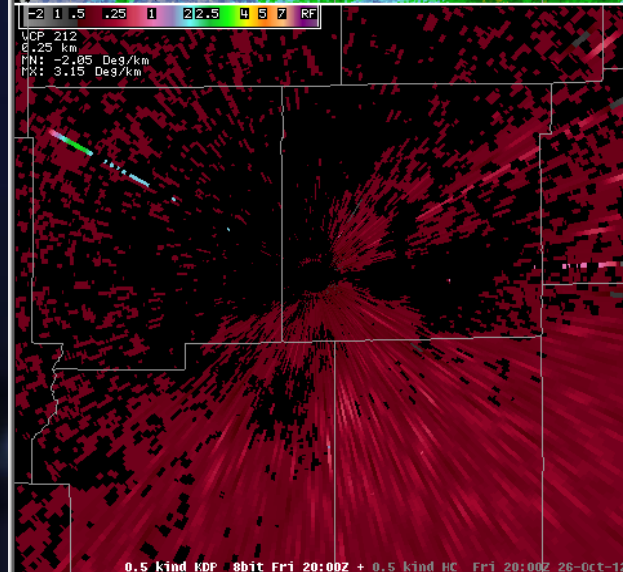
REF



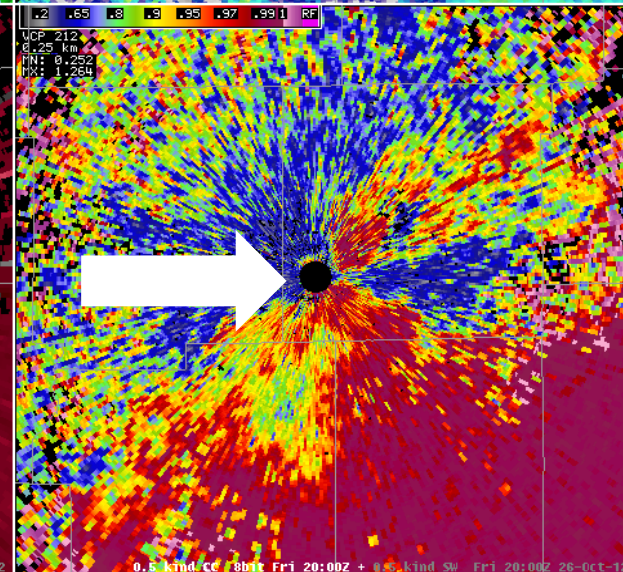
ZDR



KDP



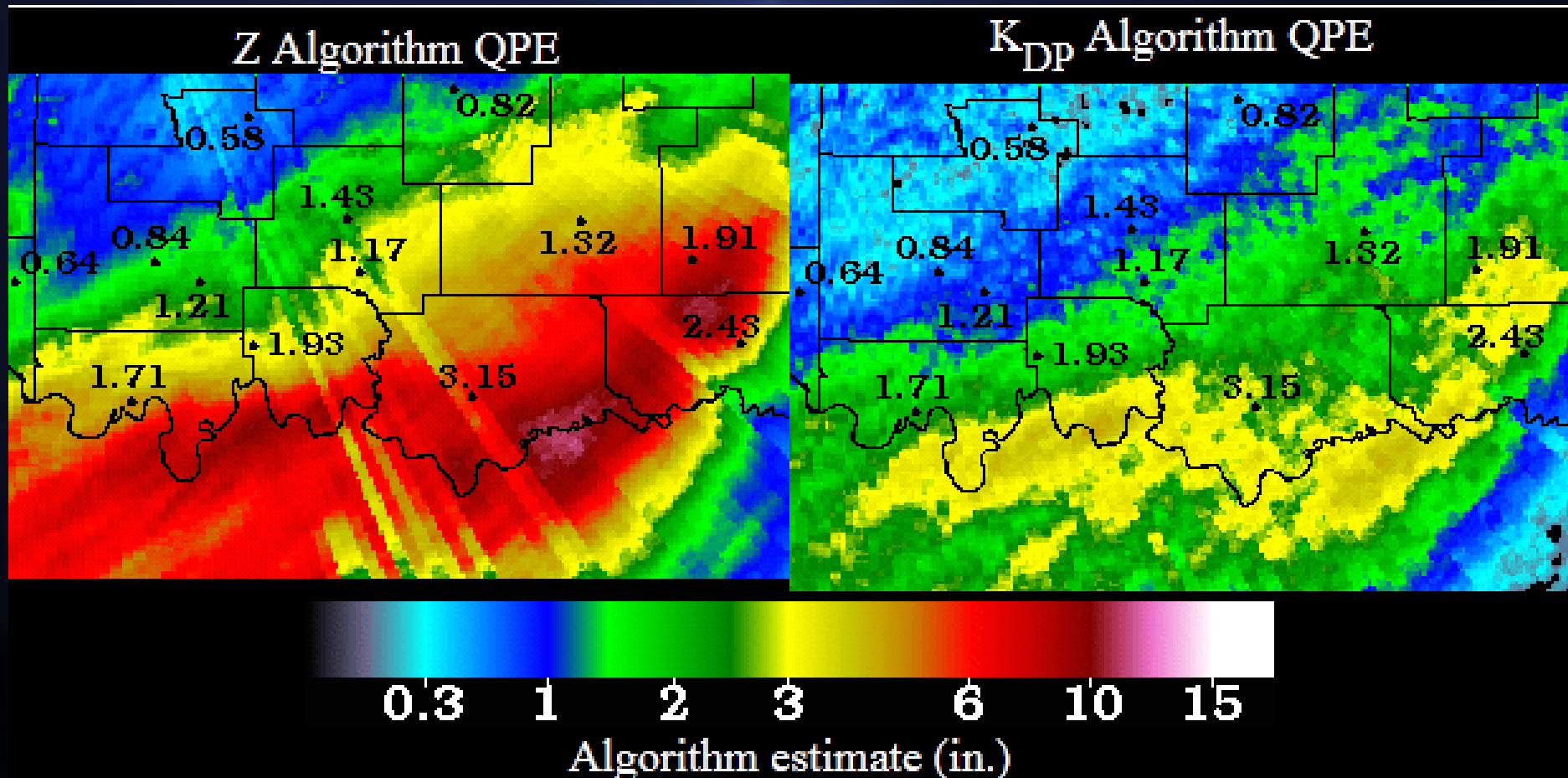
CC





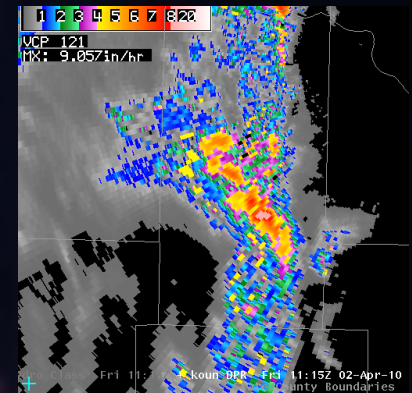
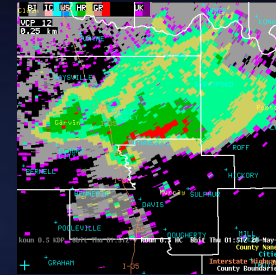
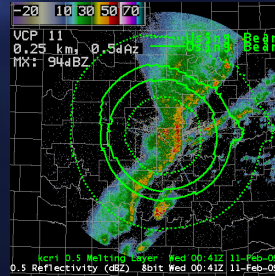
# Advantages of HCA Scheme for QPE Estimation

Below is a storm total rainfall estimate compared with Oklahoma Mesonet gauges. The KDP algorithm has is almost dead-on accurate compared with the legacy  $Z = 300 (R)^{1.4}$  relationship.



# Dual-Pol Derived Products

- Hydrometeor Classification (HC)
- Melting Layer (ML)
- Quantitative Precipitation Estimation (QPE)
- Algorithm caveats apply!!!
- Emphasis on base data interpretation



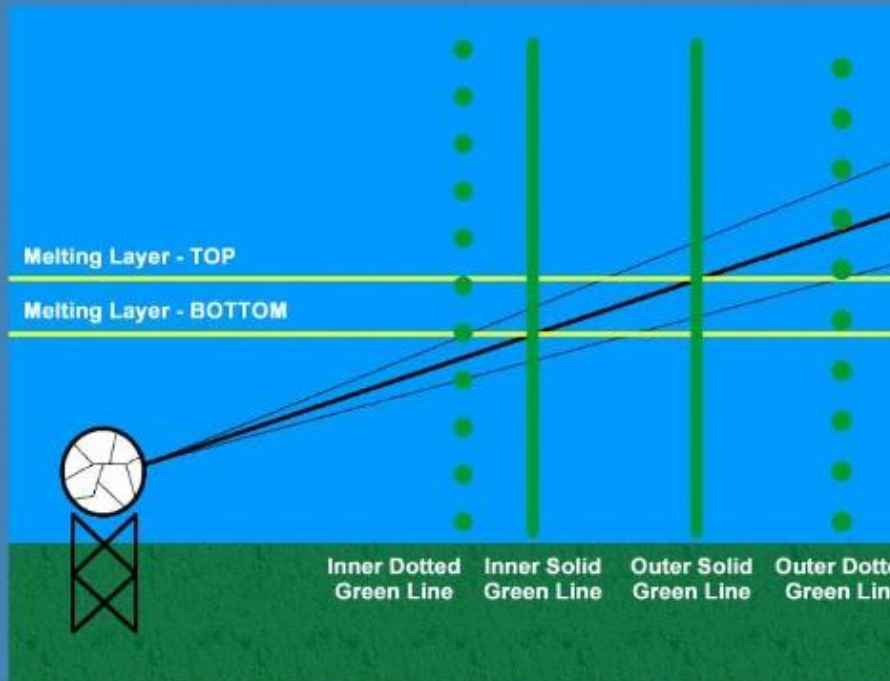


# Hydrometeor Classification

- Determines the “most likely” type
- 10 possible types – biological, ground clutter, ice, rain, hail, etc.
- Provides a quick look for areas of concern
- Used as a “safety net” do not use alone!
- Overlap between meteorological particles
- Fuzzy Logic – may need tweaking in the future
- Uncertainty information not available – one answer only – best guess!
- Be careful of HC in areas of range folding

# Melting Layer (ML)

## Conceptualizing the ML Product





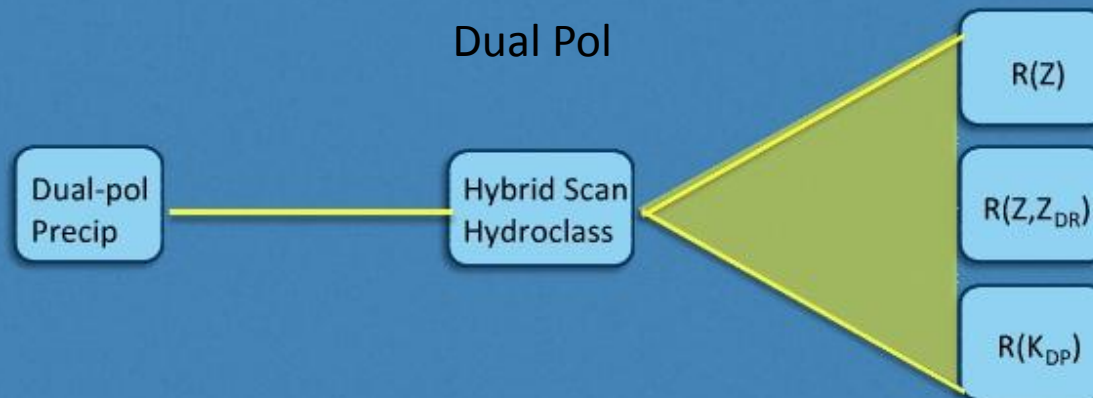
# Quantitative Precipitation Estimate (QPE)

**Purpose: QPE Specific to Hydrometeor Type!**

Current



Dual Pol



# Review

- **Correlation Coefficient (CC):**
  - The product that helps distinguish precipitation from non precipitation.
  - This product helps determine if precipitation targets have the same shape and type (e.g., pure snow or rain) or if more of a mixture exists (e.g., rain and snow).
- **Differential Reflectivity (ZDR):**
  - The product that helps identify the dominant target shape. Spherical, randomly oriented targets (e.g., hail, debris, and snow) have values near 0 while horizontally elongated targets (e.g., medium to large rain drops) have larger positive values.
- **Specific Differential Phase (KDP):**
  - Product that identifies regions of heavy rain. The higher the values are, the more intense the rain will be even if hail is present.



# Thanks to:

- Matt Friedlein – LOT
- Jami Boettcher – WDTB
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- Clark Payne - WDTB
- **Andy Kleinsasser – ICT**
- **Ken Cook – ICT**
- **Mick McGuire – ICT**
- **Steve Nelson – FFC**
- **Stephanie Dunten – BOX**
- **John Denman – LMK**
- **John Kwiatkowski – IND**
- **Ray Wolf - DVN**